

**Agilent**  
**3.125 Gb/s Serial BERT**  
**N5980A**

**User Guide**

## Notices

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[http://www.agilent.com/find/manufacturing\\_BERT](http://www.agilent.com/find/manufacturing_BERT)

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## Safety Notices

### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

### WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

# Safety Summary

## General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

## General

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

## Environment Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

## Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

## Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

## Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

## Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

## Safety Symbols on Instruments



Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.



Notice for European Community: This product complies with the relevant European legal Directives: EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC.



General Recycling Mark for plastic parts used in the product.



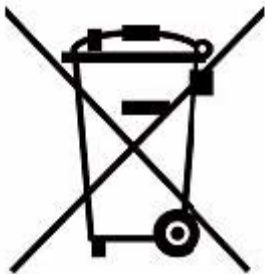
Safety requirements for electrical equipment for measurement, control, and laboratory use CAN/CSA C22.2 No. 1010.1 (1993) UL 3101, 3111 (First Editions). This equipment has also been evaluated to IEC 61010 edition 1 including amendments 1 and 2.



M10149

Conformity Mark of the Australian ACA for EMC compliance.

## Environmental Information



This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

*Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.*

**Do not dispose in domestic household waste.**

**To return unwanted products, contact your local Agilent office, or see [www.agilent.com/environment/product/](http://www.agilent.com/environment/product/) for more information.**

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# 1 Introduction

This chapter introduces you to the Serial BERT User Guide, and it provides information on the various chapters and topics covered.

- 1** Getting Started
  - Inspect Shipment
  - Connect the Instrument
  - Install User Software for N5980A
- 2** Operating N5980A with the User Interface
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  - Setting the Instrument Parameters
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- 3** Reference for the User Interface
- 4** Programming through SCPI
  - Introduction
  - Common Command Summary
  - SCPI Instrument Command List
  - Sample Code

## 2 Getting Started

### Inspect Shipment

Before you get started with the Serial BERT check if the shipment package contains the following standard deliverables:



**Agilent N5980A 3.125 GB/s Serial BERT**

**If the content is incomplete, if there is mechanical damage, or if the instrument does not work within its specifications, notify the nearest Agilent office. The Agilent office will arrange for repair or replacement without awaiting settlement.**



**SFP Loopback connector**



**Local Power Cord**



**USB Cable**



**CD (see CD content below).**

#### The CD content is:

- *Autorun.inf* – If your PC supports autorun, this file starts the installation.
- *dotnetfx.exe* - This installs the latest Microsoft .Net Framework 2.0. This should be done in case .Net Framework 2.0 is not already installed, and internet access is not available.
- *N5980A.msi* – The Serial BERT installer package
- *Setup.exe* – If your PC doesn't support autorun, execute this file to run the installation.
- *DoC.pdf* - Declaration of Conformity
- *DataSheet.pdf* – This document contains the product specifications.
- *Presales\_Presentation.pdf* – Describes typical applications.
- *UserGuide.pdf* – This document contains the details about how to use the Serial BERT.

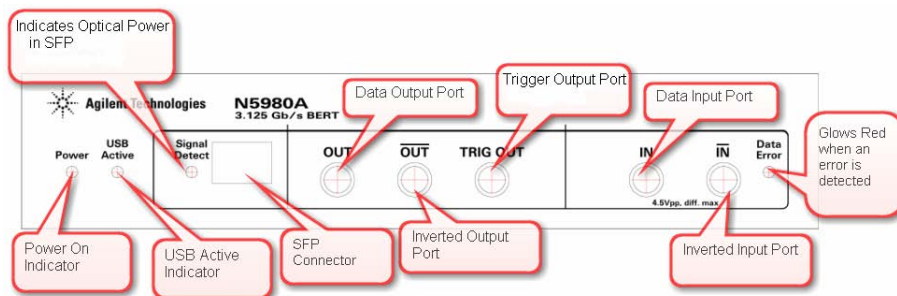


## Connect the Instrument

In order to connect the Serial BERT let's have a look at the Front and the Rear Panels:

### Front Panel

The Front Panel has LEDs, Data In/Out ports, and an SFP connector.



**Figure 1** Front Panel

### SFP

The Small Form Factor Pluggable interface (SFP) is an industry standard daughter card used in networking devices. It interfaces a network device with a networking cable. Typically SFP modules are optical transceivers using multimode (850 nm), or single-mode (1310 nm, 1550nm) cabling.

An SFP loopback connector is part of the N5980A shipment delivery. This connector is used for functional verification of the SFP port. It has an internal loop from the SFP output to the SFP input signal.

#### NOTE

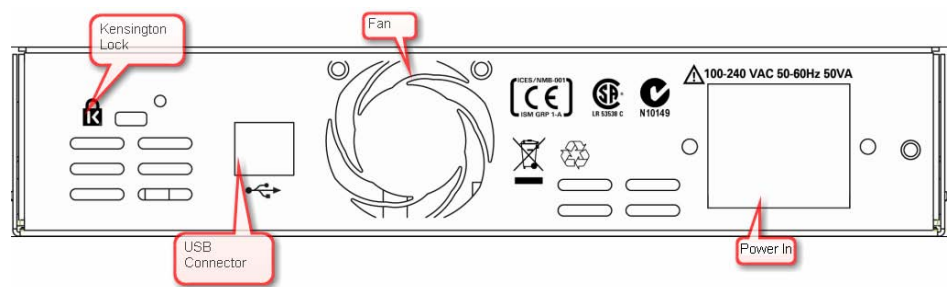
SFP compliant modules can be inserted into the SFP slot. While selecting golden SFP modules observe the specifications of the selected device. Make sure that the supported maximum PRBS length, and the maximum data rate matches with the N5980A settings. Make sure that the wavelength of the SFP module, and the cabling are identical, and that the optical power is within the specified limit. To measure BER at the SFP input, select the Input "SFP (Optical)" in the user interface.

## LED

LEDs	Function
<b>Power LED</b>	Indicates power-on
<b>USB Active</b>	Indicates that the instrument is currently being used/controlled by the user software
<b>Signal Detect</b>	Indicates the status of the Signal Detect line when the inserted SFP module supports a Signal Detect Control line. Usually this pin indicates whether the optical input power is above or within the specified range.
<b>Data Error</b>	Indicates that the error detector has detected bit errors

## Rear Panel

The Rear Panel has the USB connector, the Power in, and the safety symbols.



**Figure 2** Rear Panel

### NOTE

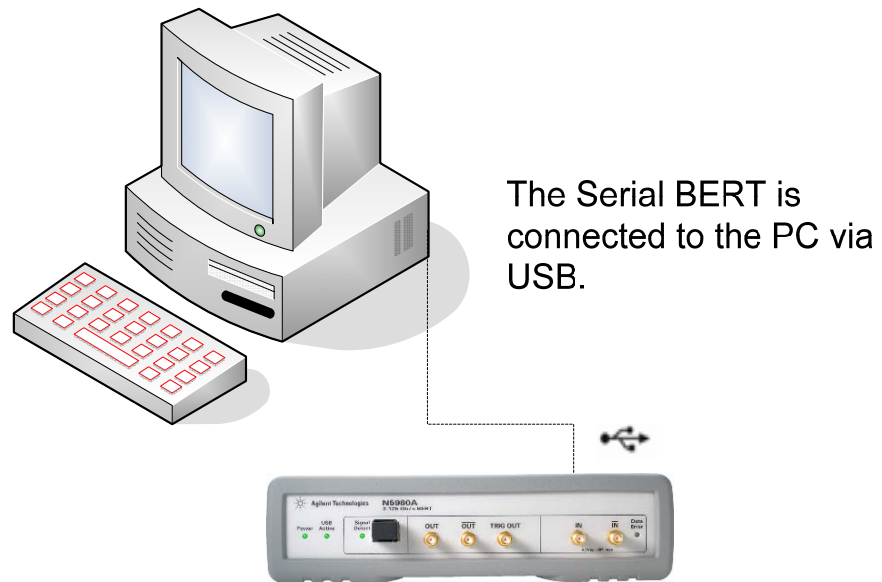
For proper ventilation keep the Serial BERT at a distance of 2 cm on both sides, and 10 cm at the back.

### To Connect N5980A

- 1 Connect the N5980A power cord at the rear panel **Power In**.
- 2 Connect the instrument, via USB, to the PC on which the User Interface will be installed.

### NOTE

Some USB hubs might decrease performance. If possible, directly connect the N5980A to your PC.



**Figure 3** Serial BERT setup diagram

## Install User Software for N5980A

The requirements for software installation:

- Either Windows 2000 Service Pack 4, or Windows XP Service Pack 2
- Microsoft .NET Framework 2.0 is automatically downloaded from the Microsoft download center during installation. Alternatively *dotnetfx.exe* may be run from the installation CD in order to install the Microsoft .Net Framework 2.0. This step should be executed in case .Net Framework 2.0 is not already installed on the computer, or the available internet connection is slow.

### NOTE

To execute the User Software, Microsoft .NET Framework 2.0 is required.

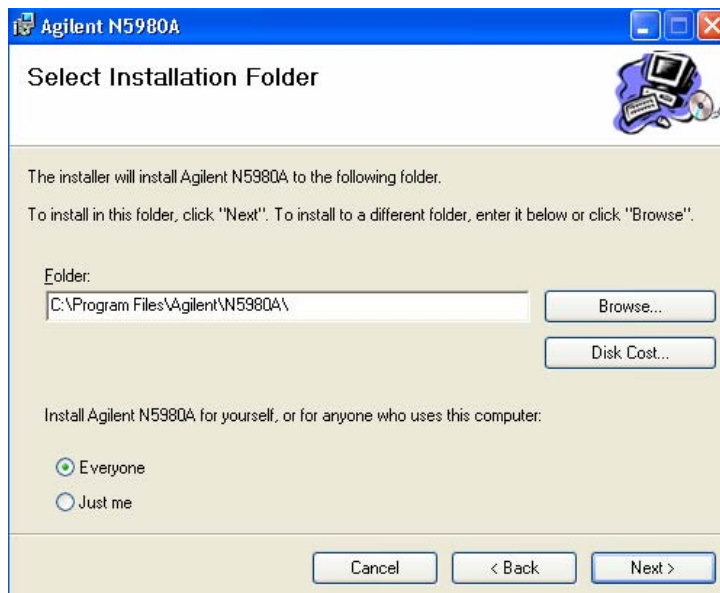
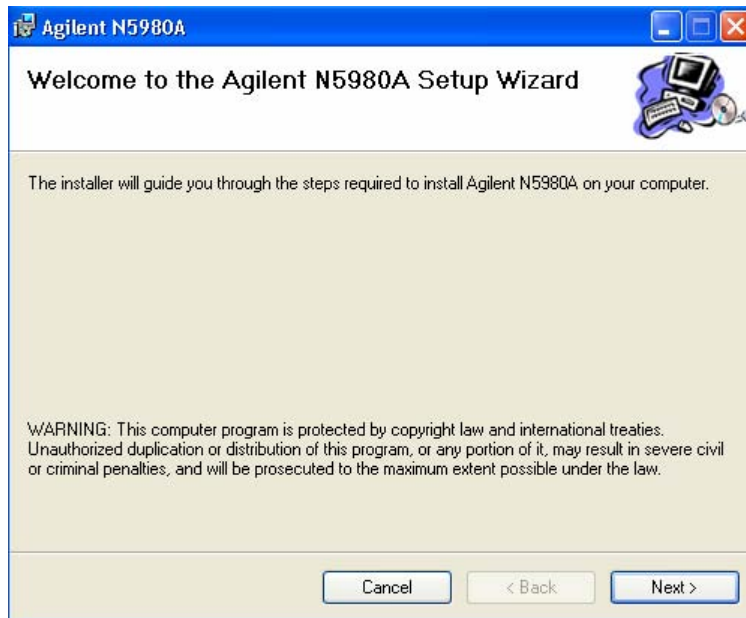
### To Install the User Software for N5980A

- 1 Insert the CD in the PC's CD Drive.
- 2 Double-click

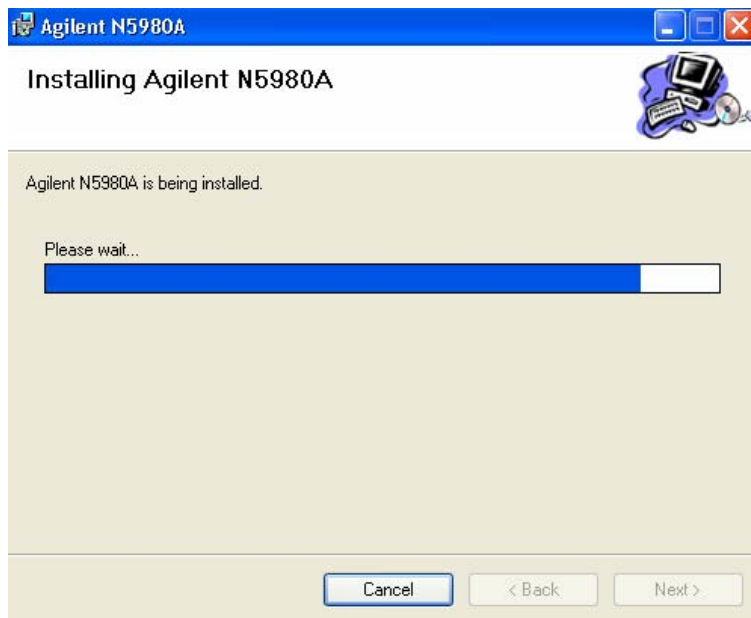
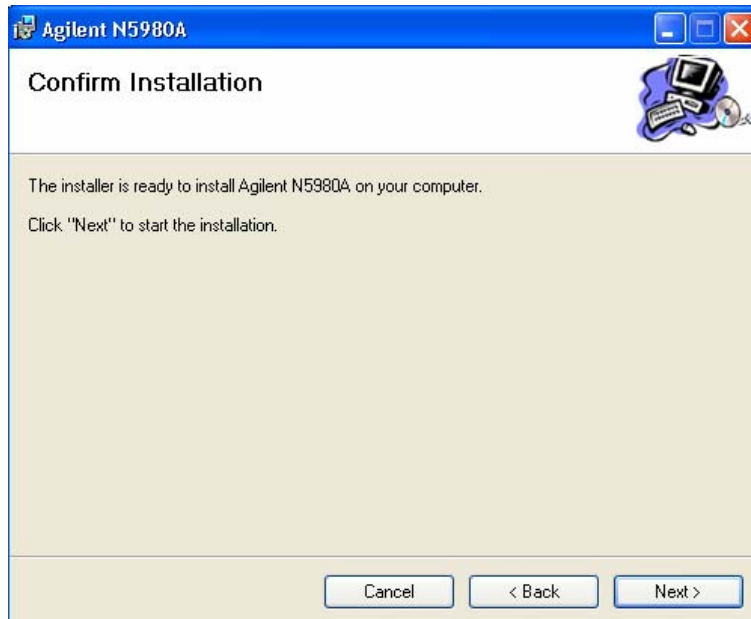


Displays the Welcome screen.

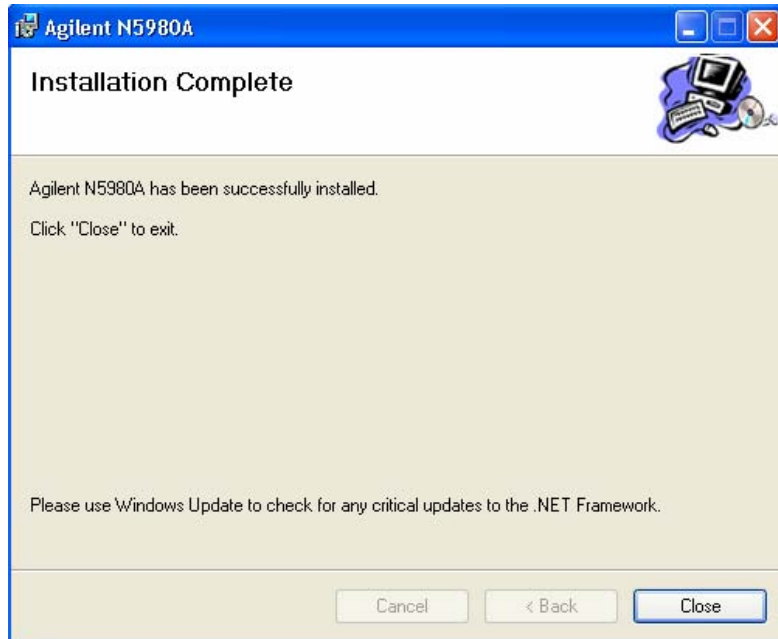
- 3 The Installer guides you through the installation process.



Select the folder in which N5980A will be saved.



After the installation is completed, click **Finish** to close the installer.

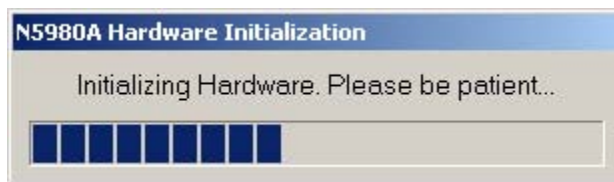


### To Access N5980A

To launch N5980A, go to **Program File** and click on:



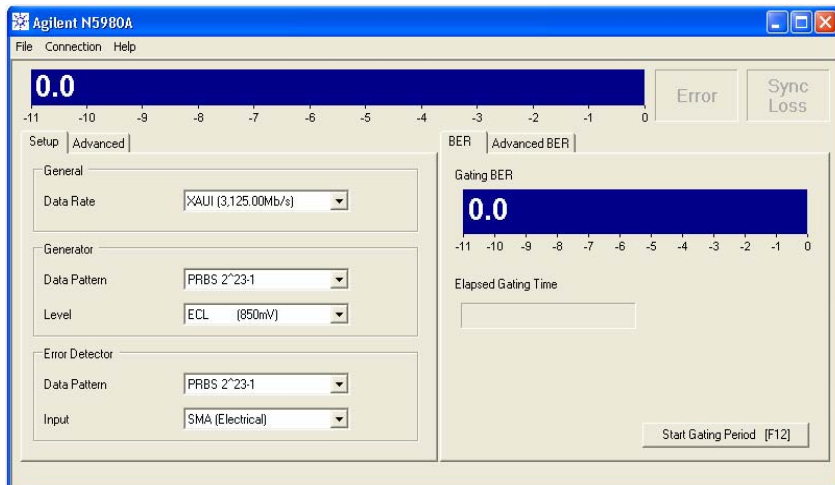
If there is a N5980A connected to the PC via USB, and the User Software is installed, then the following screen appears:



**NOTE**

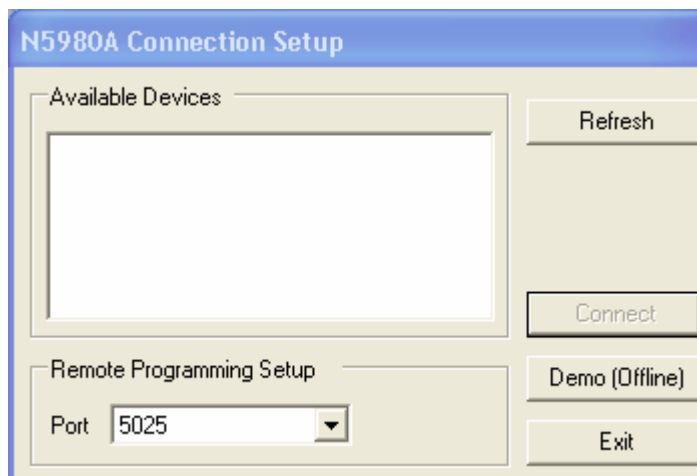
Typical Hardware Initialization duration is between 3 to 5 minutes.

Upon completion of Hardware Initialization, the User Interface starts and the following window appears.



### Demo Offline

In **Demo Offline** mode N5980A need not be connected to the PC. The connection dialog looks like the screen below.



Click **Demo (Offline)** to start the offline version of the GUI.

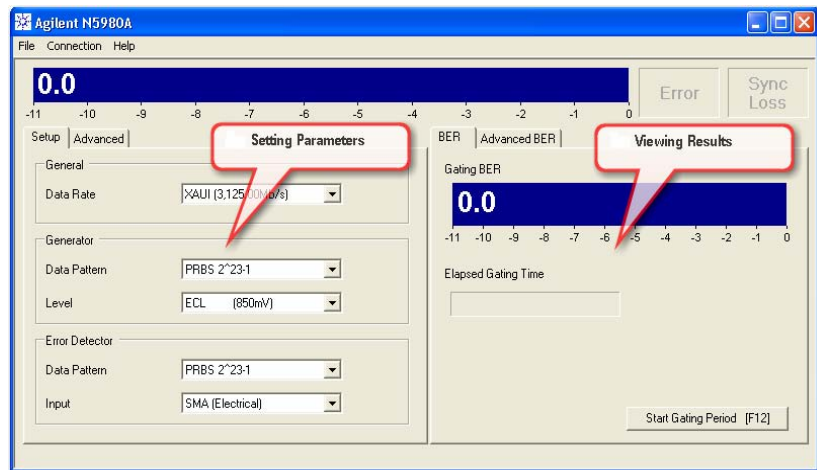
#### NOTE

Before disconnecting the USB cable, or powering down the instrument, make sure you have closed the User Software.

### 3 Operating N5980A with the User Interface

#### Introduction

The graphical user interface runs on the PC, and the screen is divided into two areas; one for setting parameters, and the other for viewing results.



The **Setting Parameters** area of the screen has options for setting parameters like Data Rate, Data Pattern and so on. The **Viewing Results** area of the screen runs the test, and displays the results.

The User Software operates in two modes, **Standard Mode** and **Advanced Mode**.

- In **Standard Mode** you can modify the basic instrument setting, and view the results.
- In **Advanced Mode** you can modify the detailed instrument settings, and view all the results.

**NOTE**

For more details check the Reference for the User Interface



## Running the BER Test

The User Software supports a quick pass/fail measurement, which is generally used for testing the DUT in manufacturing. This measurement allows you to count the number of bit errors during a user specified gating time. The result of the measurement is displayed as **Gating Errors**, **Gating BER**, and by a simple red (=fail) / green (=pass) color coding of the Gating BER bar.

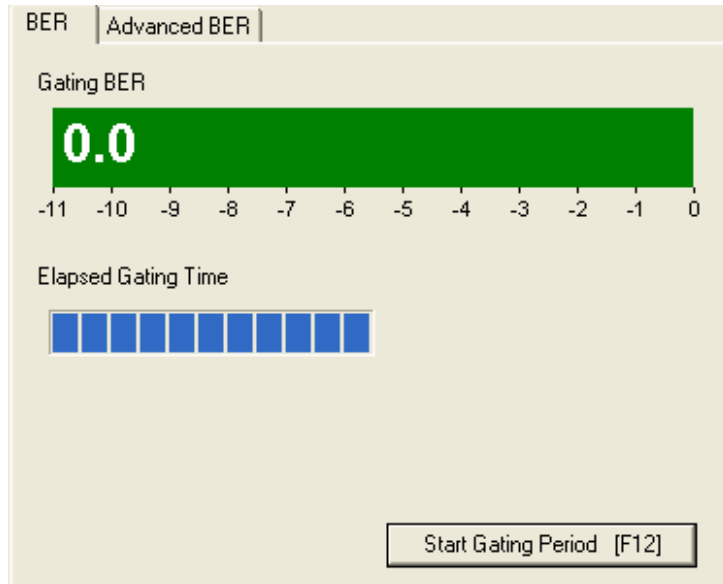
- 1 To run the basic measurement, click on **Start Gating Period** or F12.

Start Gating Period [F12]

- 2 In case you want to stop the running measurement, click on:

Abort Gating Period [ESC]

- 3 Once the measurement is complete, the results would appear as follows:



### NOTE

The **Gating Time** can be modified in Advanced Mode.

## Setting the Instrument Parameters

N5980A has two (SFP and SMA) integrated Pattern Generators, which can be adjusted to different parameters, for example, different patterns or different error insertion rates.

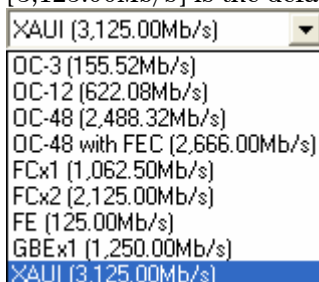
The N5980A Error Detector has two (SFP and SMA) different physical input ports, while only one input port can be analyzed at a given time. The analyzed input can be selected with the User Software.

There are two setting pages, Setup and Advanced.

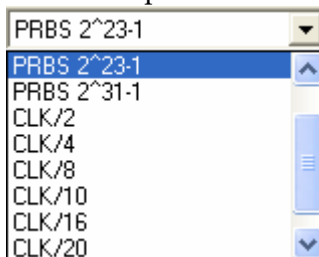
### Setup

In the **Setup page** you can change, the **Data Rate**, which applies for the Pattern Generator, and the Error Detector ; **Data Pattern** and **Logic Level** for the **Pattern Generator**; and Data Pattern and the analyzed Input of the **Error Detector**.

- 1 The following options are under Data Rate; and XAUI [3,125.00Mb/s] is the default data rate:



- 2 The **Data Pattern** of the Pattern Generator supports PRBS polynoms, clock patterns, and K28.5 pattern. PRBS 2<sup>23</sup>-1 is the default pattern:



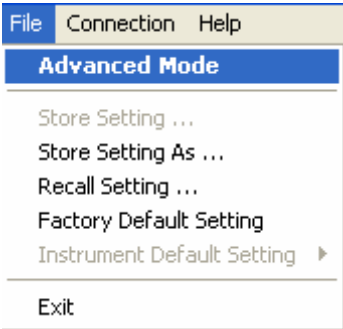
#### NOTE

Use the scroll bar to see the complete list of patterns provided.

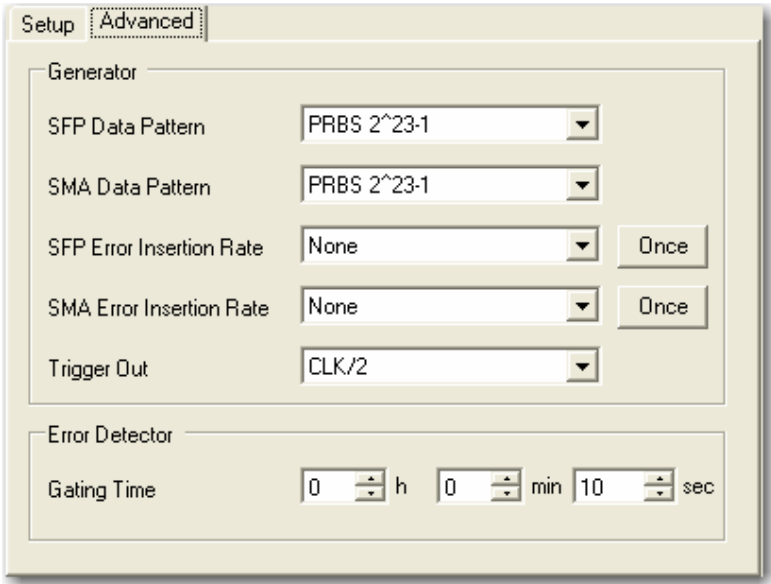
- 3 Logic Level has two options, ECL [850mV], and LVDS [400mV]. ECL [850mV] is the default level.
- 4 Error Detector Pattern. For details refer to [Error Detector](#).
- 5 Error Detector Input has two options, SMA [Electrical], and SFP [Optical]. SMA [Electrical] is the default input for the Error Detector.

**Advanced**

To view the Advanced page, click on the File menu and enable the **Advanced Mode**:



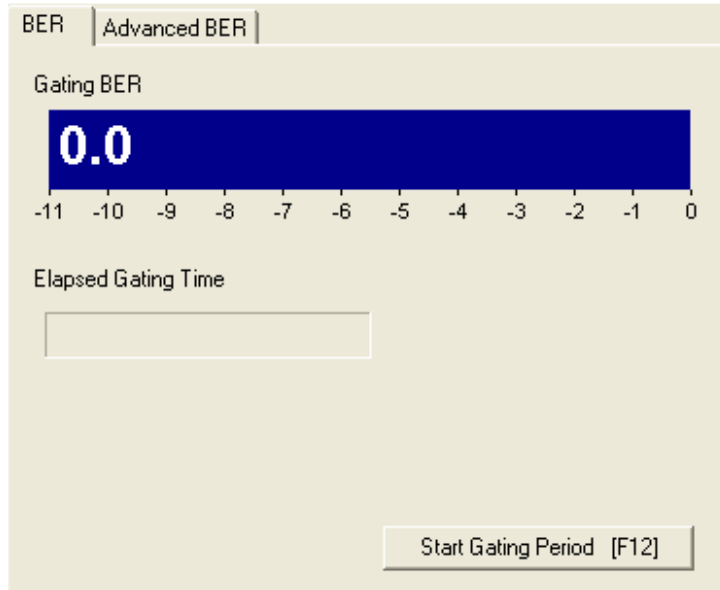
The **Advanced** page has the following settings:



In this page you can set SFP and SMA Data Patterns, Error Insertion Rate, and also select Clock Trigger Output for the Generator. It also gives the option for setting the Gating Time for the Error Detector.

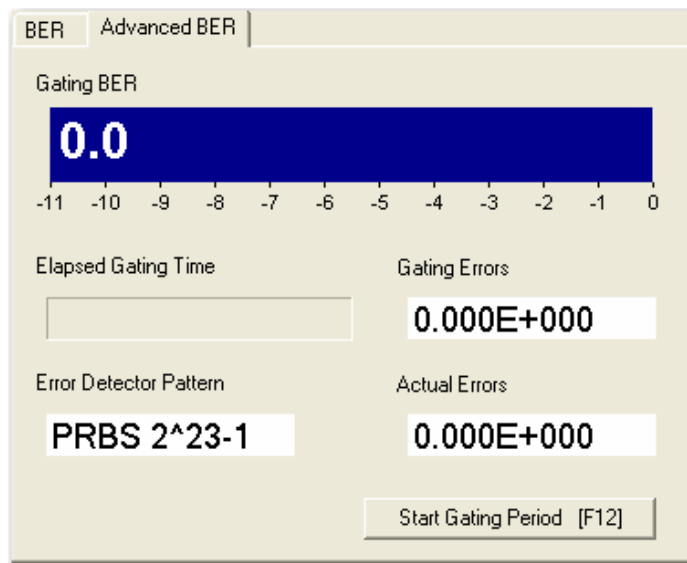
## Viewing the Results

There are two options for viewing the results, BER and Advanced BER, as shown below.



BER displays **Gating BER** and the **Elapsed Gating Time**.

The **Advanced BER** page can be opened only when Advanced Mode is enabled. See below:

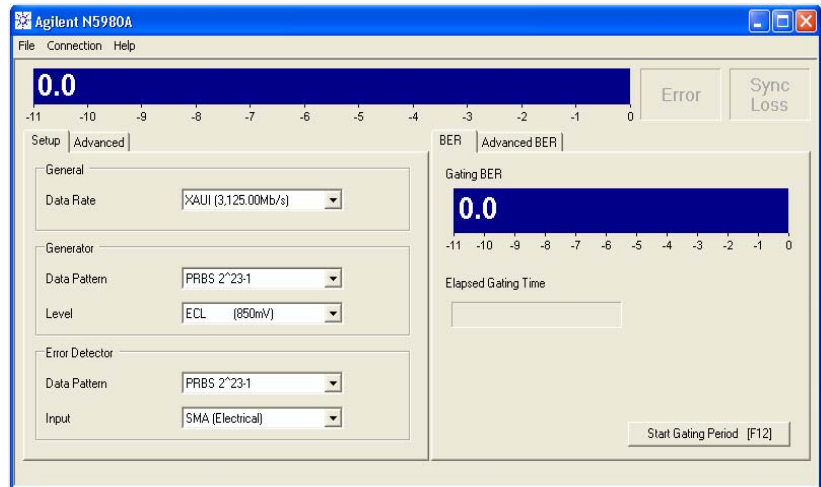


In this page you can see the **Gating Errors**, **Actual Errors**, and the **Pattern** that is currently being used by the **Error Detector**.

## 4 Reference for the User Interface

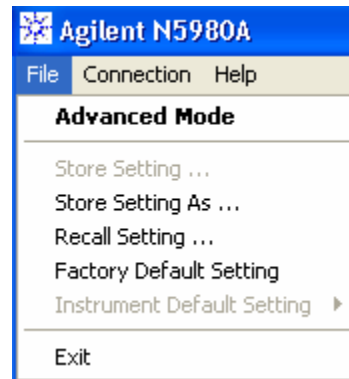
This section explains the measured parameters, and the display options that are specific to these measurements. Additionally, some information is provided to explain the theoretical background to these measurements.

When N5980A is launched the following screen is displayed:



### File Menu

The **File** menu has the following options.



#### Advanced Mode

The Advanced Mode allows you to change the settings, and view the results in the **Advanced**, and the **Advanced BER** pages.

#### Store Setting

This saves the changes made to the setting. To enable this menu option you need to store a setting first.

### Store Setting As

This is used to store/recall any setting with a user selected filename. The user selects a specific location, and file name to save the settings.

### Recall Setting

This recalls the saved settings.

### Factory Default Setting

Restores the factory default settings, and is useful when the user has problems finding a defined instrument state.

### Instrument Default Setting

This is enabled only when Advanced Mode is on. The Instrument Default Setting has three options related to the default setting.

**Store Current Setting As Instrument Default**, stores the instruments current setting as default for this instrument. The instrument default setting will be automatically applied whenever the user software connects to the instrument. The instrument default setting is stored individually for each instrument based on the instrument's serial number.

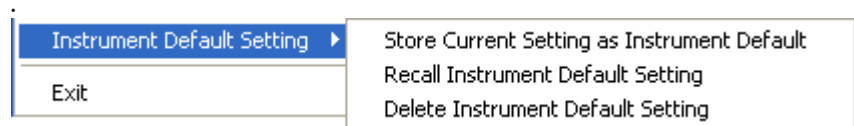
**Recall Instrument Default Setting**, recalls the instrument's default setting.

**Delete Instrument Default Setting**, deletes the instrument's default setting.

If no User Setting exists, the factory default setting will be applied when the User Software connects to the instrument.

**NOTE**

This setting is stored individually for each instrument by storing the instrument serial number in the file name.



### Exit

This closes the session with N5980A.

## Connection Menu

This has the following options:



## Connect

The **Connect...** option shows the Connection Dialog box.



### NOTE

If there are no instruments connected to the PC, then **Connect** button will be disabled. If an instrument is connected, the user can connect to that instrument.

In the **Available Devices**, the list of connected device will appear, and the **Connect** button will be enabled.

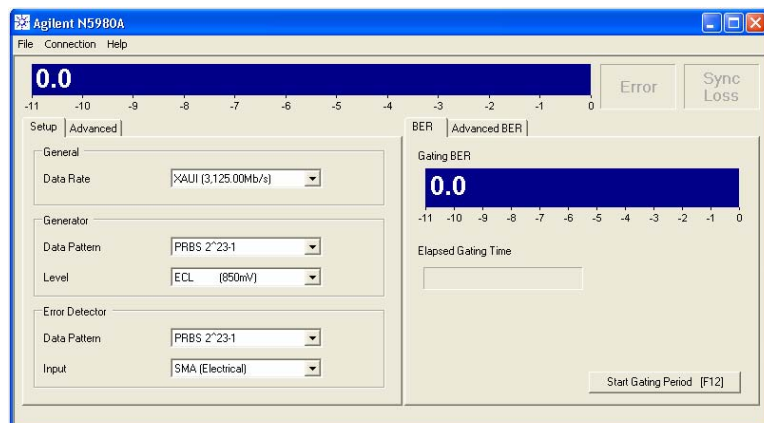
### NOTE

Each PC can control only one N5980A.

In Remote Programming Setup, a port number can be selected for the remote programming interface. The instrument will then be accessed via a socket that connects the PC's IP address and the chosen port number.

**Refresh** updates the list of Available Devices.

Selecting the connection launches the GUI, as shown below.



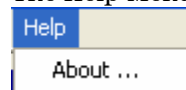
### Info

This option provides the following information.



### Help Menu

The Help Menu has the following information.

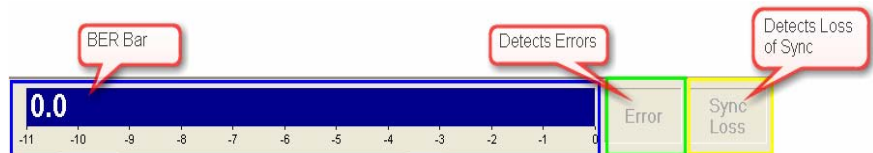


**About** gives you the Software details.



### Error Indicators

The GUI screen contains the Error Indicator:



There are two indicators and a BER bar, see the screen above. These indicators inform you about the following errors:

- Bit error in the data stream
- Loss of pattern synchronization
- Complete loss of data



### BER Bar

The BER bar displays the BER calculated during a period of 200 ms.

### Error

This indicator turns red when errors are detected.

- Stable errors are caused by the error add function: it turns SFP/SMA Error Insertion Rate off.
- Variable and high errors may be caused by faulty connectors/cables. BERT connected to your device shows:
  - Stable or variable errors caused by your device. Correct the problems with your device.
  - If the problems are not clear, then accumulate measurement data and analyze the results.

### Sync Loss

This indicator turns red when the measured BER is higher than the sync threshold of 0.1.

- The ED pattern does not match the incoming data pattern.
- Patterns have lost sync.
- The device connected to the BERT has inverted the data pattern.
- The device has changed the data pattern.

**NOTE**

Error Detector can sync only PRBS patterns. Clock patterns cannot be measured by the error detector, and will result in loss of synchronization.

---

## Setup and Advanced Tab

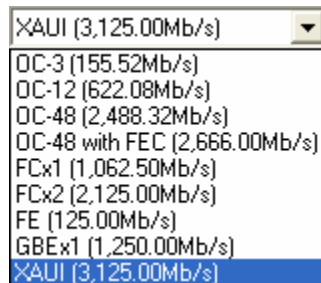
### Setup

#### General

##### Data Rate:

There are different data rates in the drop down list. These rates are common to the Generator, and the Error Detector.

The following screen lists the available Data Rates.



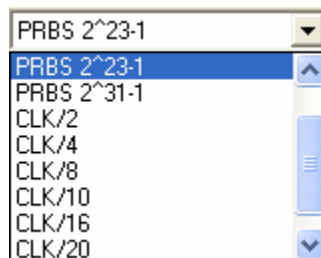
#### Generator

##### Data Pattern:

There are different patterns available, for example, PRBS patterns, Clock patterns, and K28.5 pattern.

#### NOTE

The drop down screen below lists the available patterns. To view all the patterns use the scroll bar.



##### Level:

There are two levels provided, the **ECL** and the **LVDS**.

## Error Detector

### Data Pattern:

The Error Detector (ED) has a built in CDR for automatic clock recovery, and phase alignment. The ED also performs automatic polarity correction when required. Additionally it can detect the incoming PRBS. The input for the Data Pattern has two options, SMA [Electrical], and SFP [Optical]. SMA [Electrical] is the default input for the Error Detector.

<b>Automatic</b>	Error Detector determines the incoming data stream automatically. The supported data streams are: PRBS 2 <sup>7</sup> -1 PRBS 2 <sup>15</sup> -1 PRBS 2 <sup>23</sup> -1 PRBS 2 <sup>31</sup> -1
<b>SFP (Optical Generator)</b>	The data pattern is taken from the current setting on the SFP generator output.
<b>SMA (Electrical Generator)</b>	The data pattern is taken from the current setting on the SMA generator output.
<b>PRBS 2<sup>7</sup>-1</b>	A PRBS 2 <sup>7</sup> -1 is used for pattern synchronization.
<b>PRBS 2<sup>15</sup>-1</b>	A PRBS 2 <sup>15</sup> -1 is used for pattern synchronization.
<b>PRBS 2<sup>23</sup>-1</b>	A PRBS 2 <sup>23</sup> -1 is used for pattern synchronization.
<b>PRBS 2<sup>31</sup>-1</b>	A PRBS 2 <sup>31</sup> -1 is used for pattern synchronization.

### Input:

There are two inputs to the Error Detector, the **SMA (Electrical)**, and the **SFP (Optical)**.

## Advanced

In the **Advanced** tab you can separately set the Data Patterns, and Error insertion for the SFP and SMA generator outputs.

### Generator

#### SFP Data Pattern:

In this drop down list you have the same set of patterns, as in the setup page, to select from. The selected pattern will affect the SFP output.

#### SMA Data Pattern:

In this drop down list you have the same set of patterns to select from. The selected pattern will affect the SMA output.

**NOTE**

On the advanced page the SFP and the SMA Data pattern can be adjusted independently.

**SFP Error Insertion Rate:**

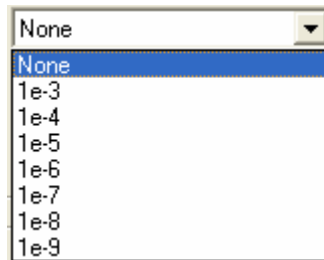
This drop down list gives a set of Error Insertion Rates that can be inserted for the SFP output.

**SMA Error Insertion Rate:**

This drop down list gives a set of Error Insertion Rates that can be inserted for the SFP output.

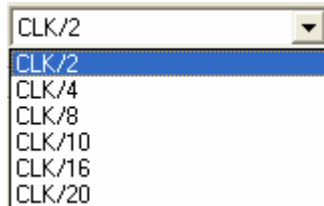
**NOTE**

Both the lists contain the same set of Error Insertion Rates. The following screen shows this list.



**Trigger Out:**

The **Trigger Out** lists a set of clock triggers. The list is shown below:



**Error Detector**

**Gating Time:**

The **Gating Time** can be set in terms of hour, minute, and seconds. The maximum gating time is 168 hours 59 minutes and 59 seconds.

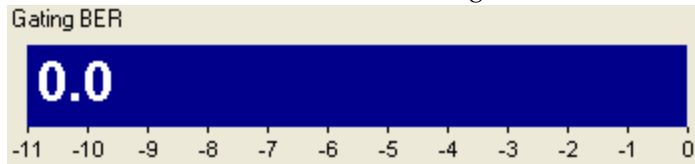
**BER and Advanced BER Tab**

**BER**

**Gating BER Bar**

This BER Bar indicates the Bit Error during the Gating Period. Once the Gating Period is complete this Bar turns green if the test passes (Gating BER is 0.0), and turns red if the test fails (Gating BER > 0.0).

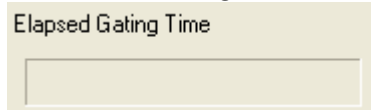
The screenshot below shows the Gating BER Bar.



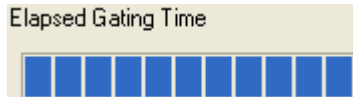
### Elapsed Gating Time

This bar shows the gating time while the test runs.

Before the test begins this bar is empty as shown below:



And after the gating time is complete this bar appears as shown below:



### Advanced BER

This page contains Gating Error, Actual Error, Error Detector Pattern Gating BER Bar, and Elapsed Gating Time.

### Gating Errors

This indicates the number of Errors that occurred during the gating time.

### Actual Errors

This indicates the number of errors that occurred during the last update interval of 200ms.

### Error Detector Pattern

This displays the pattern that is currently being used by the Error Detector.

## 5 Programming Reference

### Introduction

The SCPI commands represent the instrument's advanced analysis, and pattern generation features that can be controlled from within the remote programs.

Programming can only be done using raw Windows Sockets. The remote programming language is close to SCPI, but it's without a full featured SCPI parser.

Thus N5980A is not SCPI1997 compliant.

The missing standard SCPI features:

- Status handling/registers
- Support of short and long form of SCPI commands (the commands must be sent exactly like noted below)
- No default suffixes.
- Only a few of the standard commands (e.g. \*OPC is missing)

The commands must always be complete, even for the second parameter that belongs to the same root node inside a transaction.

Example:

```
SCPI allows:      :SOUR1:PATT PRBS7;EADD ONCE
N5980A needs:    :SOUR1:PATT PRBS7; :SOUR1:PATT:EADD
                  ONCE
```

See Sample Code

as an example to control the N5980A from within a remote program.

### Common Command Summary

```
*TST?
*OPC?
*RST
*IDN?
*OPT?
```

### Agilent N5980A Command Summary

```
:FREQ?
:FREQ

:MMEM:STOR:STAT
:MMEM:LOAD:STAT

:SYST:ERR?

:SOUR1:PATT
:SOUR1:PATT?
:SOUR1:PATT:EADD
:SOUR1:PATT:EADD:RATE?
:SOUR1:PATT:EADD:RATE
```

```

:SOUR1:VOLT
:SOUR1:VOLT?

:SOUR2:PATT
:SOUR2:PATT?
:SOUR2:PATT:EADD
:SOUR2:PATT:EADD:RATE
:SOUR2:PATT:EADD:RATE?

:SOUR3:PATT?
:SOUR3:PATT

:SENS1:SYNC:TYPE
:SENS1:SYNC:TYPE?
:SENS1:PATT?
:SENS1:GATE:PER
:SENS1:GATE:PER?
:SENS1:FETC:ECO?
:SENS1:FETC:ECO:DELT?
:SENS1:FETC:ERAT?
:SENS1:FETC:ERAT:DELT?
:SENS1:INP
:SENS1:INP?
:SENS1:GATE:STAT
:SENS1:GATE:STAT?

```

## SCPI Instrument Command List- Reference

The following reference section lists the instrument commands. The commands are described, and in addition the available attributes for certain commands are also described.

### Common Commands

#### ID Query

	<b>*IDN?</b>
<b>Syntax</b>	*IDN?
<b>Description</b>	<p>Reads the identification string from the instrument. The format of the identification string is:</p> <p>Agilent Technologies,Product Number,Serial Number,Revision Info</p> <p>Product Number is currently N5980A.</p> <p>Serial Number is read from the instrument hardware (0 if offline).</p> <p>Revision Info consists of:</p> <p>Application Revision (Microsoft w.x.y.z format)</p> <p>Instruments Firmware Revision (Major.Minor, 0 if offline)</p> <p>Hardware Revision (0 if offline)</p>

### Read error queue

**:SYST:ERR?**

**Syntax** :SYST:ERR?

**Description** Reads one error from the instruments error queue.

### Load factory default setting

**\*RST**

**Syntax** \*RST

**Description** Discards the current instrument setting, and loads the reset/default setting.

### Operation complete

**\*OPC?**

**Syntax** \*OPC?

**Description** Returns 1 when all pending commands have been executed. Blocks until all pending commands are executed.

### Option Query

**\*OPT?**

**Syntax** \*OPT?

**Description** Reports all instrument options. Currently the instrument does not have any option, so this query reports 0.

Output: always return 0

### Self test

**\*TST?**

**Syntax** \*TST?

**Description** Performs the instrument selftest. Returns 0 in case of success and 1 in case of errors during the selftest. Error messages that are discovered during the selftest will be stored in the instrument's error queue.



### Store current setting

**:MMEM:STOR:STAT "filename"**

**Syntax** :MMEM:STOR:STAT "filename"

**Description** Stores the current setting into the specified file. If a file with the same name already exists, then this file will be overwritten.

### Recall setting

**:MMEM:LOAD:STAT "filename"**

**Syntax** :MMEM:LOAD:STAT "filename"

**Description** Loads stored instrument setting from the given file.

### All Channels

#### Datarate

**:FREQ**

**Syntax** :FREQ?

:FREQ FE

OC3 | OC12 | OC48 | OC48FEC | FC1 | FC2 | GBE1 | XAUI

**Description** Either sets or gets the instrument's datarate. The datarate always applies to all the channels (electrical out, optical out, clock out, and error detector input).

#### Available Data Rates

Name	Frequency	Parameter
Fast Ethernet	125.00Mb/s	FE
OC-3	155.52Mb/s	OC3
OC-12	622.08Mb/s	OC12
OC-48	2.48832Gb/s	OC48
OC-48 with FEC	2.666Gb/s	OC48FEC
1 x FC	1.0625Gb/s	FC1
2 x FC	2.125Gb/s	FC2
Gigabit Ethernet	1.25Gb/s	GBE1
XAUI	3.125Gb/s	XAUI

## SMA Output (Electrical Generator)

The SMA output is accessed via the root node :SOUR1

### Pattern

**:SOUR1:PATT**

**Syntax** :SOUR1:PATT?  
 :SOUR1:PATT  
 PRBS7 | PRBS15 | PRBS23 | PRBS31 | CLK2 | CLK4 | CLK8 | CLK10 | CLK16  
 | CLK20 | K28\_5

**Description** Either sets or gets the pattern of the SMA output.

Available Patterns	Name	Parameter
	PRBS 2 <sup>7</sup> -1	PRBS7
	PRBS 2 <sup>15</sup> -1	PRBS15
	PRBS 2 <sup>23</sup> -1	PRBS23
	PRBS 2 <sup>31</sup> -1	PRBS31
	Clock / 2	CLK2
	Clock / 4	CLK4
	Clock / 8	CLK8
	Clock / 10	CLK10
	Clock / 16	CLK16
	Clock / 20	CLK20
	K28.5	K28_5

## Error Insertion

The error insertion is capable to enforce a given error ratio, and to add single errors into the data stream. Both are available in parallel.

### Insertion Rate

**:SOUR1:PATT:EADD:RATE**

**Syntax** :SOUR1:PATT:EADD:RATE?  
:SOUR1:PATT:EADD:RATE NR3

**Description** Either sets or gets the error insertion rate. Only the listed error rates are available. If another value is specified while sending the command, the error rate will be rounded to the next available value.

#### Available Insertion Rate

Inserted error rate	Parameter
None	0
1e-3	1e-3
1e-4	1e-4
1e-5	1e-5
1e-6	1e-6
1e-7	1e-7
1e-8	1e-8
1e-9	1e-9

### Add Single Error

**:SOUR1:PATT:EADD**

**Syntax** :SOUR1:PATT:EADD ONCE

**Description** Adds a single error to the generated data stream. This is available even if the cyclic error insertion is active.

### Output Level

**:SOUR1:VOLT**

**Syntax** :SOUR1:VOLT?  
:SOUR1:VOLT ECL|LVDS

**Description** This either sets or gets the output level. The output is always AC. Specifying the output level actually changes only the amplitude of the generated electrical signal.

#### Available Output Levels

Parameter	Level
ECL	850mV
LVDS	400mV

## SFP Output (Optical Generator)

The SFP output is accessed via the root node :SOUR2

### Pattern

**:SOUR2:PATT**

**Syntax** :SOUR2:PATT?  
 :SOUR2:PATT  
 PRBS7 | PRBS15 | PRBS23 | PRBS31 | CLK2 | CLK4 | CLK8 | CLK10 | CLK16  
 | CLK20 | K28\_5

**Description** Either sets or gets the pattern of the SFP output.

#### Available Patterns

Name	Parameter
PRBS 2 <sup>7</sup> -1	PRBS7
PRBS 2 <sup>15</sup> -1	PRBS15
PRBS 2 <sup>23</sup> -1	PRBS23
PRBS 2 <sup>31</sup> -1	PRBS31
Clock / 2	CLK2
Clock / 4	CLK4
Clock / 8	CLK8
Clock / 10	CLK10
Clock / 16	CLK16
Clock / 20	CLK20
K28.5	K28_5

### Error Insertion

The error insertion is capable to enforce a given error ratio, and to add single errors into the data stream. Both are available in parallel.

### Insertion Rate

**:SOUR2:PATT:EADD:RATE**

**Syntax** :SOUR2:PATT:EADD:RATE?  
:SOUR2:PATT:EADD:RATE NR3

**Description** Either sets or gets the error insertion rate. Only the listed error rates are available. If another value is specified while sending the command, the error rate will be rounded to the next available value.

### Available Insertion Rate

Inserted error rate	Parameter
None	0
1e-3	1e-3
1e-4	1e-4
1e-5	1e-5
1e-6	1e-6
1e-7	1e-7
1e-8	1e-8
1e-9	1e-9

### Add Single Error

**:SOUR2:PATT:EADD ONCE**

**Syntax** :SOUR2:PATT:EADD ONCE

**Description** Adds a single error to the generated data stream. This is available even if the cyclic error insertion is active.

## Trigger Output

The trigger output is accessible via the root node :SOUR3

### Pattern

**:SOUR3:PATT**

**Syntax** :SOUR3:PATT?

:SOUR3:PATT CLK2 | CLK4 | CLK8 | CLK10 | CLK16 | CLK20

**Description** Either sets or gets the pattern of the trigger output.

#### Available Patterns

Name	Parameter
Clock / 2	CLK2
Clock / 4	CLK4
Clock / 8	CLK8
Clock / 10	CLK10
Clock / 16	CLK16
Clock / 20	CLK20

## Error Detector

The Error Detector channel is accessed via the root node :SENS1

### Detected Pattern

**:SENS1:PATT?**

**Syntax** :SENS1:PATT?

**Description** Gets the pattern that is currently used on the Error Detector to compare it with the incoming data stream. This might change when the Error Detector detects a very high error ratio, and tries to synchronize with the incoming data.

#### Response

Error Detector Pattern	Response
PRBS 2 <sup>7</sup> -1	PRBS7
PRBS 2 <sup>15</sup> -1	PRBS15
PRBS 2 <sup>23</sup> -1	PRBS23
PRBS 2 <sup>31</sup> -1	PRBS31
Error Detector has lost pattern synchronization.	UNKNOWN

### Synchronization mode

**:SENS1:SYNC:TYPE**

**Syntax** :SENS1:SYNC:TYPE  
 AUTO | SFP | SMA | PRBS7 | PRBS15 | PEBS23 | PRBS31  
 :SENS1:SYNC:TYPE?

**Description** Either sets or gets the synchronization type. The synchronization type defines which patterns will be used to synchronize when a synchronization loss is detected by the Error Detector.

**Available Synchronization Types**

Parameter	Synchronization behavior
AUTO	The Error Detector will use all available patterns to synchronize with the incoming data stream.
SFP	The Error Detector will use only the pattern that is set for the SFP output.
SMA	The Error Detector will only use the pattern that is set for the SMA output.
PRBS7	The Error Detector will only use a PRBS $2^7-1$ data stream.
PRBS15	The Error Detector will only use a PRBS $2^{15}-1$ data stream.
PRBS23	The Error Detector will only use a PRBS $2^{23}-1$ data stream.
PRBS31	The Error Detector will only use a PRBS $2^{31}-1$ data stream.

### Actual Bit Error Rate

**:SENS1:FETC:ERAT:DELT**

**Syntax** :SENS1:FETC:ERAT:DELT?

**Description** Gets the bit error ratio of the last update interval (approx 200ms).

### Actual Number of Errors

**:SENS1:FETC:ECO:DELT**

**Syntax** :SENS1:FETC:ECO:DELT?

**Description** Gets the number of errors that have been counted during the last update interval (approx. 200ms).

### Gating Time

**:SENS1:GATE:PER**

**Syntax** :SENS1:GATE:PER?  
:SENS1:GATE:PER integer

**Description** Either gets or sets the duration of the gating interval. The allowed range for the gating time is 1s to 608399s (168 hours, 59 minutes, 59 seconds). The gating time is always in seconds. Fractional seconds are not supported, and will be rounded to the closest time in seconds.

### Gating Bit Error Rate

**:SENS1:FETC:ERAT**

**Syntax** :SENS1:FETC:ERAT?

**Description** Gets the bit error ration that is captured during the gating interval. This value might/will change while the gating is in progress, and will freeze at the end of the gating interval.

### Gating Number of Errors

**:SENS1:FETC:ECO**

**Syntax** :SENS1:FETC:ECO?

**Description** Gets the number of errors that have been counted during the gating interval. This value might/will change while gating is in progress, and will freeze at the end of the gating interval.

### Start Gating

**:SENS1:GATE:STAT 1**

**Syntax** :SENS1:GATE:STAT 1|ON

**Description** Starts a new gating period. This command will be ignored if a gating period is already in progress.

### Abort Gating

**:SENS1:GATE:STAT 0**

**Syntax** :SENS1:GATE:STAT 0|OFF

**Description** This command aborts the currently active gating period immediately. It will be ignored if the gating is not in progress.



## Gating Progress

### **:SENS1:GATE:STAT**

**Syntax** :SENS1:GATE:STAT?

**Description** Requests the current state of the gating interval. It will return 1 while the gating is in progress and 0 if the gating is finished/ inactive. It is guaranteed that the very first :SENS1:GATE:STAT? query after the start of the gating period will report a valid state of the gating progress. There is no need to capture 0-1-0 transitions of the gating progress.

## Input Selection

### **SENS1:INP**

**Syntax** SENS1:INP SFP|SMA

**Description** Selects the input for the error detector.

## Sample Code

The following example code shows how to control the N5980A from within a remote program. The example code is implemented in C#.

The code snippets show the required code that needs to be added to a user program.

It implements a class N5980A in the namespace N5980AExample that allows communication with the N5980A user software.

```
using System;
using System.Collections.Generic;
using System.Text;
using System.Net;
using System.Net.Sockets;
using System.Windows.Forms;

namespace TBertExample
{
    class N5980A
    {
        /// <summary>
        /// Holds the input buffer when reading from the socket.
        /// </summary>
        byte[] bufferin = new byte[64 * 1024];

        /// <summary>
        /// Holds the TcpClient that is used to establish the
        /// remote connection.
        /// </summary>
        TcpClient m_Client = null;

        /// <summary>
        /// Holds the NetworkStream that provides the communication
        link.
        /// </summary>
        NetworkStream m_Stream = null;

        /// <summary>
        /// Connect to the instrument with the given hostname and
        /// port number. Both values can be retrieved by the
        /// Connection -> Info... menu item in the N5980A software
        /// </summary>
        /// <param name="host">Hostname of the PC that executes
        /// the N5980A software.</param>
        /// <param name="port">Port number of the software instance
        /// to communicate with.</param>
        public void Connect(string host, int port)
        {
            try
            {
                // resolve address of the given hostname
                IPHostEntry ipHostEntry = Dns.Resolve(host);
                IPAddress ipAddress = ipHostEntry.AddressList[0];
                // create TcpClient and connect it to the instrument
                m_Client = new TcpClient();
                m_Client.Connect(new IPEndPoint(ipAddress, port));
                m_Stream = m_Client.GetStream();
            }
            catch (Exception e)
            {
                MessageBox.Show(e.Message, "Connect");
            }
        }

        /// <summary>
        /// Close the connection with the N5980A software.
    }
}
```

```

    /// </summary>
    public void Disconnect()
    {
        if (m_Client != null)
            m_Client.Close();
    }

    /// <summary>
    /// Write to a SCPI command to a network socket and return
the
    /// response if it was a query.
    /// </summary>
    /// <param name="s">SCPI command to be written to the
socket</param>
    /// <returns>Response of the instrument or an empty string
    /// if there is no response.</returns>
    public string Send(string s)
    {
        string response = "";
        int i;
        // Write the string to the network socket
        byte[] bufferout = new byte[s.Length + 1];
        for (i = 0; i < s.Length; i++)
            bufferout[i] = (byte)s[i];
        bufferout[s.Length] = (byte)'\n';
        m_Stream.Write(bufferout, 0, bufferout.Length);
        // If the string contains a '?', then it is a query and
        // the response needs to be read from the instrument
        if (s.IndexOf('?') != -1)
        {
            // Read response from network stream
            int numRead = m_Stream.Read(bufferin, 0,
bufferin.Length);
            // if the response contained any bytes, then convert
them
            // to a valid string
            if (numRead > 0)
            {
                StringBuilder sb = new StringBuilder();
                for (i = 0; i < numRead; i++)
                    sb.Append((char)bufferin[i]);
                // make sure that all kind of terminators are
                // reported as \r\n
                sb.Append("\r\n");
                response = sb.ToString().Trim(new char[] { '\r', '\n'
});
                if (response.IndexOf("\r\n") != -1)
                    response = response.Replace("\r\n", "\n");
                if (response.IndexOf("\r") != -1)
                    response = response.Replace("\r", "\r\n");
                if (response.IndexOf("\n") != -1)
                    response = response.Replace("\n", "\r\n");
            }
        }
        return response;
    }
}
}
}

```

### Communicate with the instrument

Given the class above, the communication with the instrument can be done like this:

```

using System;
using System.Collections.Generic;

namespace TBertExample
{
    static class Program

```

```
{
  /// <summary>
  /// The main entry point for the application.
  /// </summary>
  [STAThread]
  static void Main()
  {
    N5980A instrument = new N5980A();
    // Connect to the N5980A software running on the same
    // PC as this program and that is using port number 5025
    instrument.Connect("localhost", 5025);
    // set the data rate to OC-3
    instrument.Send(":freq OC3");
    // read the data rate
    string response = instrument.Send(":freq?");
    // Close the socket => disconnect from the instrument
    instrument.Disconnect();
    // From here on, it is no longer possible to communicate
    with the
    // instrument.
  }
}
```